**Follow the specifications in this article,**

**and you will have long-wearing, serviceable,**

**and corrosive-resistant . . .**

# CONCRETE FLOORS

THE WEARING SURFACE of a concrete floor is no more than one inch thick. And yet the workmanship and materials that go into its construction will determine the strength and life of the floor. A floor that is properly finished will hold up under extremely severe conditions indefinitely. It will resist "dusting," and if made of a non-porous concrete will resist acids and brine solutions.

The first step in a safe procedure for finishing floors is to advise the ready mix producer precisely how the concrete is to be used and ask for his recommendations. He will prepare a mixture suitable for the type of floor that is to be constructed. The two things that then require close attention in obtaining a good floor finish are the base and the wearing surface.

## The Concrete Mix

Because of the thinness of the surface layer and the hard wear it will have to take, material selection, grading, and mixing are especially important. The ready mix producer, in preparing the concrete, pays special attention to his ingredients to obtain a mix that will give maximum strength and watertightness. He uses quality cement. The water mixed with the cement is clean, and the aggregates are clean, tough, and carefully separated according to size.

The selection and quality of aggregates is one of the most important parts of his job when preparing concrete for a floor surface. They have to be tough enough to resist abrasion and hard enough so that water will not penetrate. Gravel or crushed stone is usually selected for the purpose. Where the surface will receive especially hard wear—as in a factory—traprock and quartz are often used.

In a well-constructed floor, coarse and evenly graded aggregates are imbedded in the wearing surface. For this reason, the grading of aggregates is just as important as their quality. Here, again, the ready mix supplier will screen and select, excluding soft materials such as stonedust, clay, and silt.

Sometimes artificial aggregates, produced by the heat of electric furnaces, are used because they are tough and produce non-slip surfaces. These, too, are carefully graded.

As little water as possible is used in a concrete mixture for floors, so that the surface will be strong and

Essential operations for a good floor finish: power floating and troweling.

Photo by courtesy of Thor Power Tool Company.

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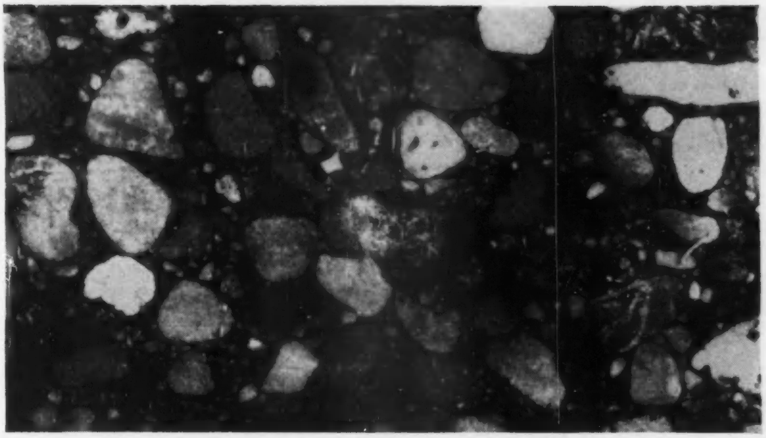
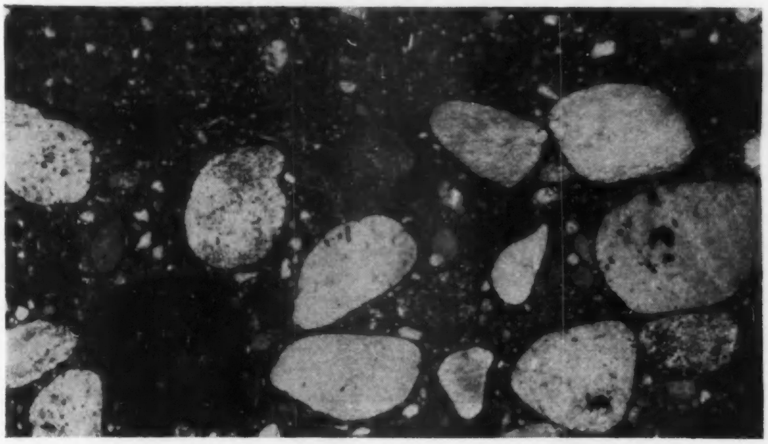
watertight. If you tell the ready mix producer, for example, that you plan to machine float, he will use no more than 3½ to 4 gallons of mixing water per sack of cement. If you tell him you expect to float by hand, he will step this figure up to 4½ or 5 gallons per sack. These amounts (including water introduced as surface moisture on the aggregates) will produce a non-porous paste to completely surround the aggregates and fill all the voids.

Generally speaking the following proportions are used by the ready mix producers for wearing surfaces: 1 part of cement, 1 part of sand, and from 1½ to 2 parts of coarse aggregate. Concrete for wearing surfaces should contain less water and more aggregate to a given amount of cement than concrete for most other purposes. The resulting stiffer mixes are desirable to prevent separation of materials, with water and fine material floating to the top. Since coarse materials have better wearing characteristics than fine materials, it is obviously important that they remain near the surface where the wear occurs. On the infrequent occasions when the mix may become too harsh to work, the ready-mix producer should be notified at once, so that he can correct the condition by adjusting the proportions of fine and coarse aggregate. This condition should not be corrected by the addition of water to the mix.



Coarse, evenly matched aggregate at the floor surface (above) makes a sturdier wearing surface than fine sand and gravel at the surface (below).



### Constructing the Base

Before placing the top surface, it is essential to construct a good base. The finish can be added after the base has hardened or while it is still wet. Most authorities recommend the first method.

Base concrete for floors placed on the ground level of a building is a mixture of not more than 6 to 6½ gallons of water per sack of cement. It should be brought to grade not less than one inch below the proposed finish level. When it has partially hardened, it should be brushed with a stiff broom. Besides cleaning the surface, this scores it to provide mechanical bond. The base should be wet-cured for at least 5 days; for at least 2 days if high early strength concrete is used. The surface should be protected from grease, dirt, and paint during the curing stage.

Just before placing the finish, the base should be thoroughly scrubbed and cleaned. Also check to make sure it is thoroughly wet, although free of pools of water. Then broom into the wet surface a slush mixture of cement and water—about the consistency of thick paint. The top surface should then be placed immediately—before the slush layer dries out.

### Placing the Surface

The finished, or wearing, surface of the floor should be at least one inch thick—whether it is placed at the same time as the base slab or after the concrete in the base has hardened.

The first step is to spread the concrete as it leaves the truck mixer with heavy shovels and garden rakes until you have a fairly uniform layer.

Then compact throughout its depth by tamping with iron tampers or rolling with weighted rollers. Any areas where it is difficult to use rollers—as in corners or around columns—should be thoroughly tamped. This gives a hard and durable surface.

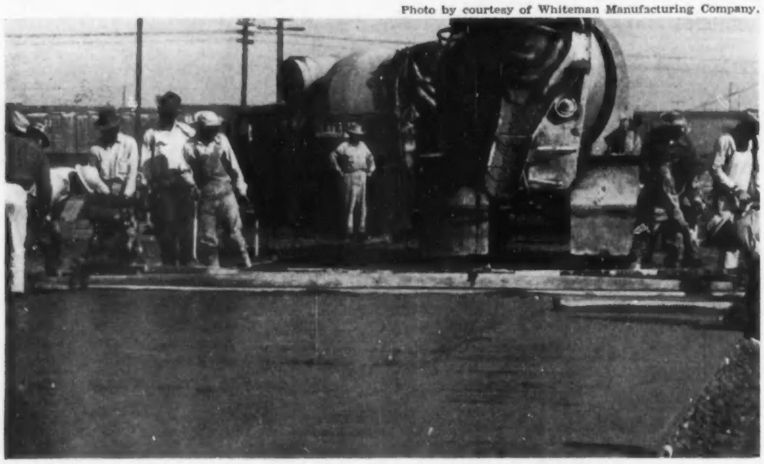
Next the concrete is screeded, or struck off to the proper level. The proper level is determined by screed strips placed parallel to each other, usually 7 feet or more apart. A scraper or screeding machine is pulled across the strips to strike off the concrete to their level. The blocks used to form the screed strips are then removed and the spaces filled with concrete.

Floating follows after this to fill up the hollows and iron out the final bumps. Mechanical floating machines are available which will compact and float mixtures much stiffer and harsher than can be floated by hand. If mechanical floats are used, the mixture should be so stiff that when a sample is squeezed in the hand only a slight amount of moisture comes up to the surface. Because the amount of mixing water can thus be kept to a minimum, mechanical floating on floor surfaces has a great advantage over hand methods.

The machine is operated by means of a handle over the surface of the

Bonding the structural slab with a stiff broom produces a coarse surface texture that should look like the above.

Photo by courtesy of Whiteman Manufacturing Company.



Screeding machine striking off the proper level for a factory floor.

floor. The rotating of the flat disk compacts the concrete and floats out the moist surface to a smooth finish.

When floating is done by hand, both a short and long float are used to produce an even, plane finish. The longer float removes any of the hollows still left by the short type. At this stage, there should be no water appearing on the surface of the concrete.

**Finishing the Surface**

Where a mechanical float is used, troweling may be done immediately after floating. Troweling must be done with special care so that moisture and fine materials are not drawn to the surface. Final troweling is done after the concrete has completely hardened. At this stage, a ringing sound is produced as the trowel polishes the surface to a smooth finish.

After the first troweling, however, an important stage intervenes — the curing process. During this process, it is extremely important to prevent the rapid evaporation of water. For only while the concrete is kept moist can the chemical reactions between cement and water take place at a rate that builds up strength, resistance to wear, and watertightness.

Close attention to the curing process is important with floor finishes because such a large expanse of fresh concrete is exposed to evaporation of its moisture into the air. One method for keeping the concrete wet is to seal in the moisture as soon as possible by covering the floor with waterproof paper or a membrane curing compound. These coverings should be kept constantly wet. Especially watch the moisture in areas near heat sources, such as indoor radiators or artificial heating devices used in cold weather construction.

The longer the curing period can be extended, the stronger the wearing surface will be. Allow at least a week's curing period for normal portland cement, and at least three days for high early strength portland cement.

Extra precaution should be taken during cold weather to protect the concrete from freezing until it has gained sufficient strength so that it will not be damaged. When necessary, heating equipment should be provided throughout the curing period.

The temperature of the concrete supplied you should be as near as possible to that of the base slab. Warm concrete placed on a very cold hardened slab will not bond well and when the top layer is cooled, it may shrink and break away from the slab.

The final steps in finishing the floor are grinding and cleaning. After the surface has hardened enough so that aggregate particles won't be chipped out, it should be ground down with a grinding machine. The floor should be kept moist during this process. All loose particles ground off should be removed. Any pits in the surface can then be filled with a cement paste. A second and final grinding gives the finish a polish. The floor should then be thoroughly washed and protected from building debris until the structure is completed.

**Resurfacing**

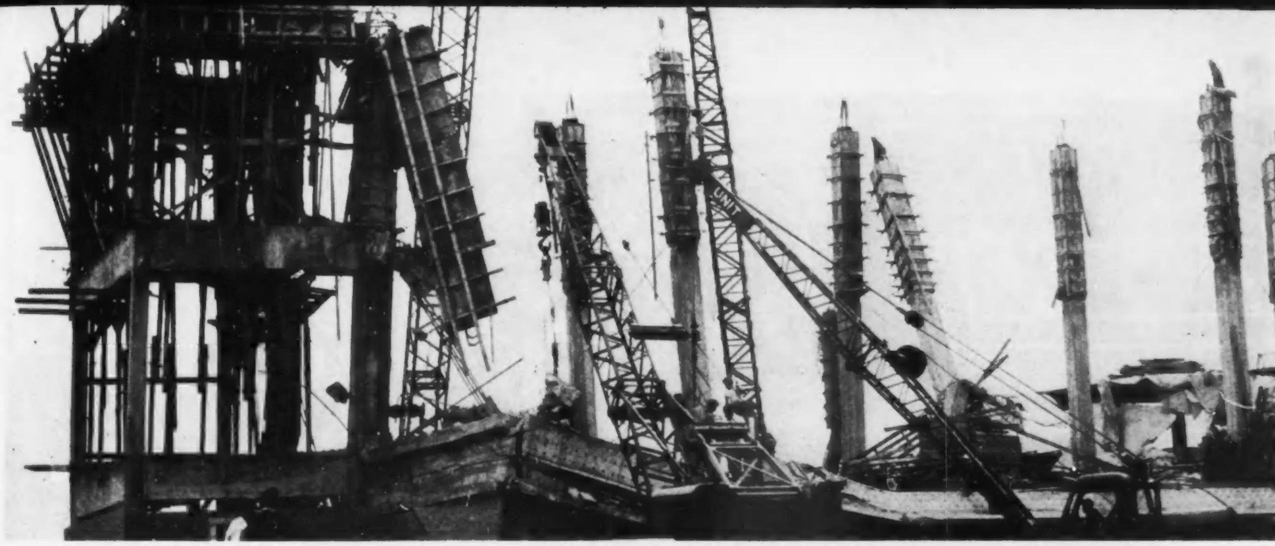
In resurfacing an old floor, you are faced with either of two possibilities: (1) The old floor level must be preserved and the worn surface chipped off. (2) The floor level may be raised because it would be impractical to chip off the old surface.

If you have to remove the old surface, chip it away to a depth of at least one inch. Then thoroughly clean away all loose material before beginning work on the new surface.

Where the old surface is to remain, clean it thoroughly of all loose material, dust, paint, grease, or oil. Any smooth areas in the old concrete should be roughened. Then thoroughly moisten the surface, but make sure that no pools of water remain when you're ready to place the new finish.

First, a thin coat of neat cement grout is broomed into the surface. Before this hardens, the new finish should be placed to a thickness of about one inch. Wire mesh (not less than 30 pounds per 100 square feet) is laid next, and placing of the wearing finish resumed to a total thickness of not less than two inches. Striking off, compacting, and floating complete the job.

END



Columns of ruined structure remain standing, showing necked-down areas where floors had been placed.

# Construction Failure at Jackson, Michigan

AT LEAST TEN MEN were killed and 15 others injured in the sudden collapse of a wing of a four-story reinforced concrete office building in Jackson, Michigan, on October 3. The failure occurred without warning shortly after concrete had been placed for the top floor of the structure.

More than 2,000 tons of concrete, representing floor construction in a section three bays wide by about six bays long, was dropped into the basement at a time when some 130 men were at work. Serious as the death and injury toll was, many of the workmen escaped unscathed by the narrowest of margins. Two cement finishers are reported to have ridden the collapsing floors clear to the basement and survived.

Contrary to early newspaper reports, there seems to be no evidence to indicate that the tragedy was triggered in any way by too-early stripping of forms. A report by *Engineering News-Record* states that the first and second floors had cured for several weeks, and the forms and shoring had been removed. Concrete in the third floor was 20 days old: forms had been stripped and the floor reshored.

Speculation at the moment is that the failure may have occurred as the result of punching shear of the flat-plate 10-inch-thick concrete floors at the columns. Although the slabs were integral with the columns, the section available for punching shear was reduced substantially by duct and piping openings along some interior columns. The floors were supported on square columns spaced on 24-foot centers. There were no drop panels or column capitals.

Damage to beam and slab construction adjoining the section of the building that collapsed.

According to the latest information available to CONCRETE CONSTRUCTION magazine, at least seven independent investigations of the disaster are either in progress or in prospect. These include studies by the contractors (Herlihy Mid-Continent Company of Chicago), the insurance companies, the State Legislature, the State Labor Commission, and the Consumers Power Company, owners of the building.

END

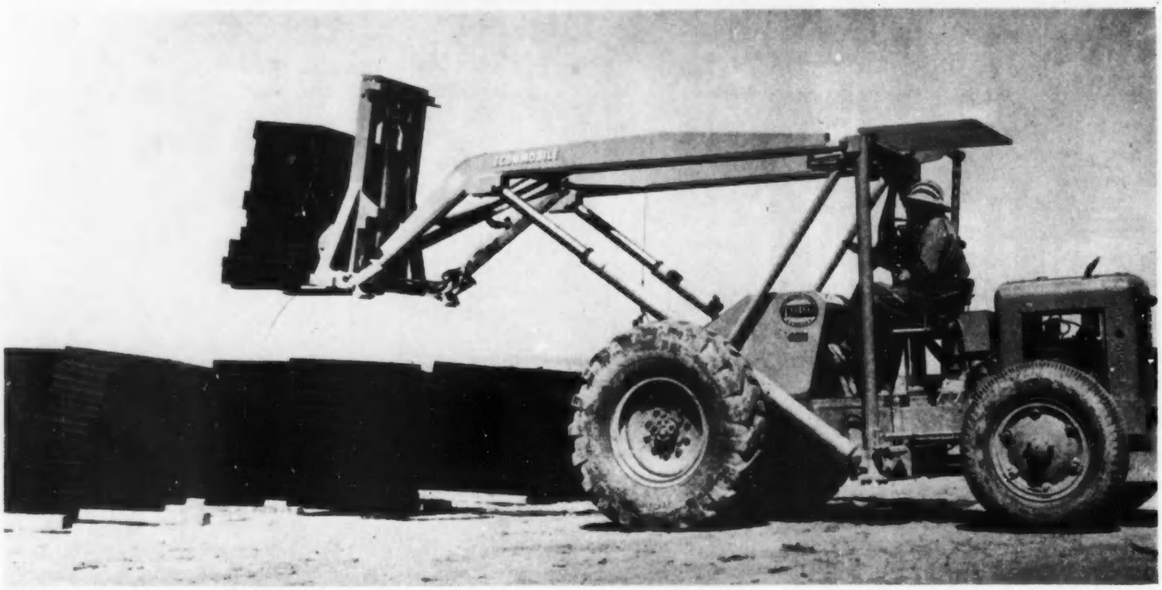


Photo by courtesy of American Road Equipment Co.

Prefab forms are quickly and easily carried about by modern material-handling equipment—a significant cost- and labor-saving advantage.

# Prefab Forms Keep Pace with Building Needs

BY JOHN G. SYMONS
*President,*
*Symons Clamp & Manufacturing Co.*

**In scarcely more than ten years, mass production of prefab forms has brought new speed and economies into the construction industry**

FOR THOSE OF US who have "grown up" in the business it is hard to realize that the manufacture of prefabricated forms is scarcely more than ten years old. As is true in so many industries, the mass production of forms was developed in answer to specific needs—in this case to help take care of the tremendous backlog of construction that accumulated during World War II.

When we look back now, the reasons for turning to prefab forms are obvious. The need for speed was, of course, a major factor. Building forms on the job requires a lot of time—time the contractor could more profitably spend superintending the job. Prefabs also permit a contractor to start the job much faster—without waiting until forms are hammered together.

While speed is a factor, an even more compelling reason for the building industry to turn to prefabs was economy. Competition became keener than ever before. Jobs had to be figured close, and any device which permitted labor-saving short cuts immediately became important to the industry. Prefab manufacturers gained acceptance, too, by offering contractors the option of either outright purchase, rental, or rent applying on the purchase of forms. This enabled large and small contractors to compete for the same jobs on an equal basis.

The industry can now look back with some amusement at the first crude prefabs. Many of them were made of yellow pine and spaced in a kind of log cabin effect. The important thing, of course, is that they did the job so well that contractors found them essential to their business.

Engineering and field service offered by some manufacturers helped speed the trend toward the use of prefab forms. Today most manufacturers will take a contractor's plans and prepare complete form layouts and bills of materials without cost to the contractor. Field service men also offer on-the-job advice on how forms can be used most efficiently, or in overcom-

ing unusual problems that may arise.

Although evolution came fast, we would be less than generous if we didn't pay tribute to those far-seeing contractors who helped "sell" concrete as a basic construction medium. Name your structure and chances are some enterprising contractor or architect is now thinking in terms of how concrete can be used to answer his problem. The quality of concrete itself has been steadily improved, making it possible to use the material in many new ways. The greatly expanded use of prestressed concrete is an outstanding example of this. Job-built forms simply can't be used to cope with all modern structural demands.

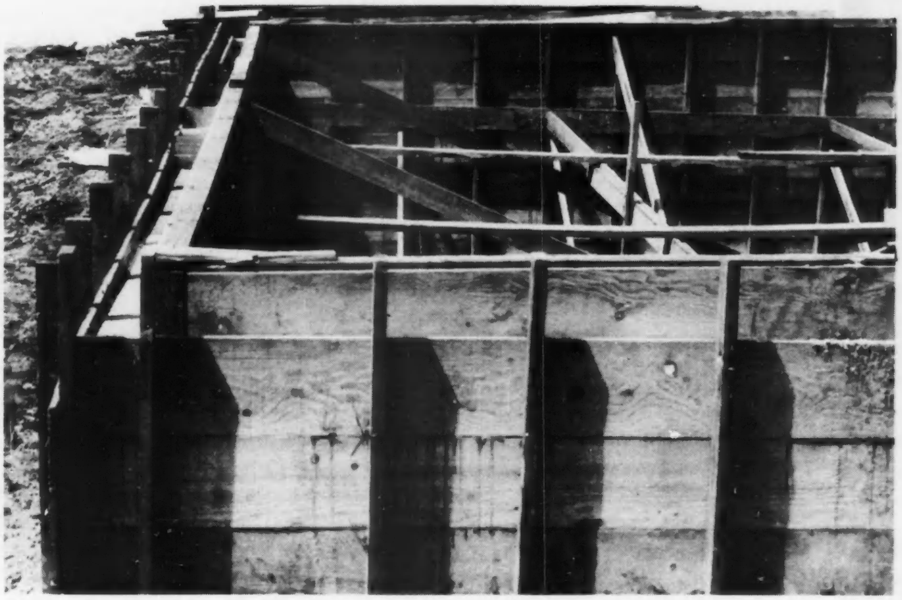
Manufacturers have had to answer this need. The trend has had to be toward lighter forms which can bear an increasing load. The growth of the use of magnesium in forming is a story in itself. It has doubled each year for the past ten years, and no volume contractor can afford to compete without using it in some type of form. Magnesium forms can be used literally hundreds of times and still retain their smoothness and load-bearing qualities. Volume usage makes their slightly higher first cost insignificant.

Plywood has been improved and will continue to be as it is adapted to new uses. Plastic coating has added many reuses to plywood prefabs and cut down the unit cost materially. Reusable magnesium-plywood forms are the answer for the medium-to-small contractors. Most forms of this type pay for themselves after the 100th usage.

In addition to these forms, however, the concrete contractor has at his disposal steel frame, all wood, and wood-with-steel-cross-member forms—all designed for a specific purpose or cost objective.

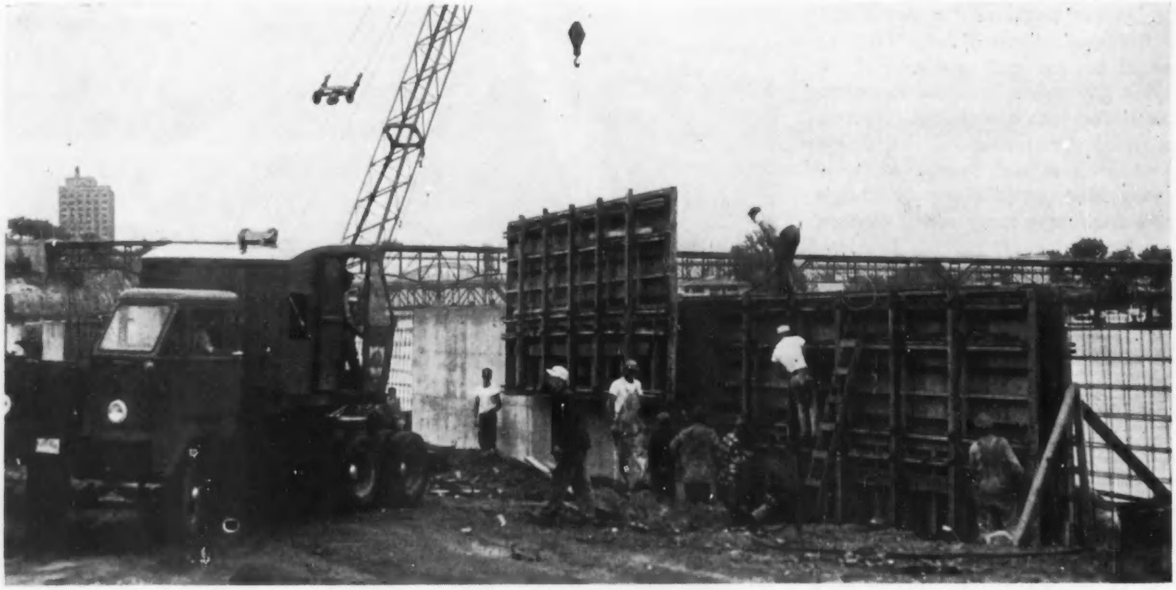
Forming hardware is also a beneficiary of the trend to fast erection and stripping. Even scaffolding and bracing is prefabricated so that the contractor need spend no time at all on this otherwise time consuming detail work.

Extensive research is going on to find materials still more adaptable to the complex forming problems of to-



**Before the advent of prefab forms, ordinary one-inch planks were used in assembling forms on the job site.**

**In contrast to the crude plank forms above, this illustration shows steel-frame prefab forms in place for pouring basement.**



In gang forming, shown here, whole units are lifted into place at once—a technique which saves costly manhours.

Illustrated is another type of modern prefab form, which features wooden frame and steel cross members.

day. Glass is considered another possible material—glass and stainless steel or magnesium can make a rigid form that will withstand much abuse.

Gang forming is still another new frontier for the industry. The many uses of this new approach to forming are still being studied. Lift the whole forming unit into place with a crane and you save many costly hours of labor—a major factor in bidding.

We manufacturers are pleased to be associated with a growth industry. Proof of this growth is readily apparent to us this year when, despite a drop of more than 25 per cent in home building, the loss was more than offset by the continuing boom in general construction. The gains that will accrue from the multi-billion highway building program are still being assessed.

Competition is as keen if not keener in our business than in the concrete contracting field. The unusual fact is its stability. Each year about as many enter it as drop out. In short, it is no bed of roses. Many see it as an easy money enterprise. Those who fail invariably have tried to cut costs by using inferior materials and workmanship. The successful manufacturer works closely with the men in the field, tries to anticipate demand, and offers a quality product that satisfies close profit margins. No one doing any volume of concrete construction work today should be fully satisfied with his performance in respect to either cost or quality until he has fully investigated the possibilities of prefab forms.

END

# Poured Basements versus Block

BUILDERS EVERYWHERE will be interested in a study of the comparative costs and advantages of poured concrete and concrete block basements recently completed by the Milwaukee Builders Association. The study is of particular interest because Milwaukee has long been considered a block town so far as basement work was concerned.

Although the area has a vigorous and well developed ready-mixed-concrete industry, local builders have continued to use block for basement work because they were familiar with the material and they believed it had marked cost advantages over poured concrete. Several factors, however, have tended to bring costs into balance. The wide use of patented forming systems has made it possible to hold the line on the cost of poured work, while the steady increase in labor cost has probably had a disproportionate effect on the over-all cost of block walls, since the poured basement utilizes a greater proportion of material to labor than does the block basement.

A more recent trend with a direct bearing on the problem has been the gradual introduction of modular block measuring 7⅝ inches high in place of the traditional full 8-inch-high unit. While the modular unit has important advantages that show up in total cost of construction, the local builders have objected to it for basement work because a 10-course wall built of such units will not meet FHA requirements for minimum basement heights. They contend that the additional cost of laying a 10½-course or 11-course wall has largely cancelled the price advantage of the block basement.

The recent study by the Milwaukee Builders Association was undertaken in order to develop as much factual and unprejudiced information as possible on the present costs of various types of basement construction. For purposes of the study a 24-by-40-foot basement, complete with footings, waterproofing and including all material and labor, was examined from the standpoint of poured concrete, full 8-inch block, and modular (7⅝-inch-high) block for both frame and veneered homes. All prices were taken as of September 1, 1956, in the Milwaukee area. In addition to initial costs, consideration was also given to structural advantages, performance, and repair and maintenance costs.

On the face of it, the Milwaukee Builders Association has done a workmanlike job of fact finding. Since the technical committee which undertook the investigation wisely resisted the temptation to draw any conclusions, we are following their example. The accompanying data actually tells a remarkably complete story, and we believe the tabulated list of advantages and disadvantages for the two types of construction represents a fair appraisal of the facts. CONCRETE CONSTRUCTION will be pleased to hear from any of its readers who have undertaken similar cost studies. END

*(See next page for charts on comparative cost studies.)*

## POURED

### advantages

Stronger
More waterproof
Finish more versatile
Potentially lower cost
Fewer call backs

### disadvantages

Curing time longer (4 days)
Few contractors
Cracks almost impossible to repair
Winter work at present time more difficult

---

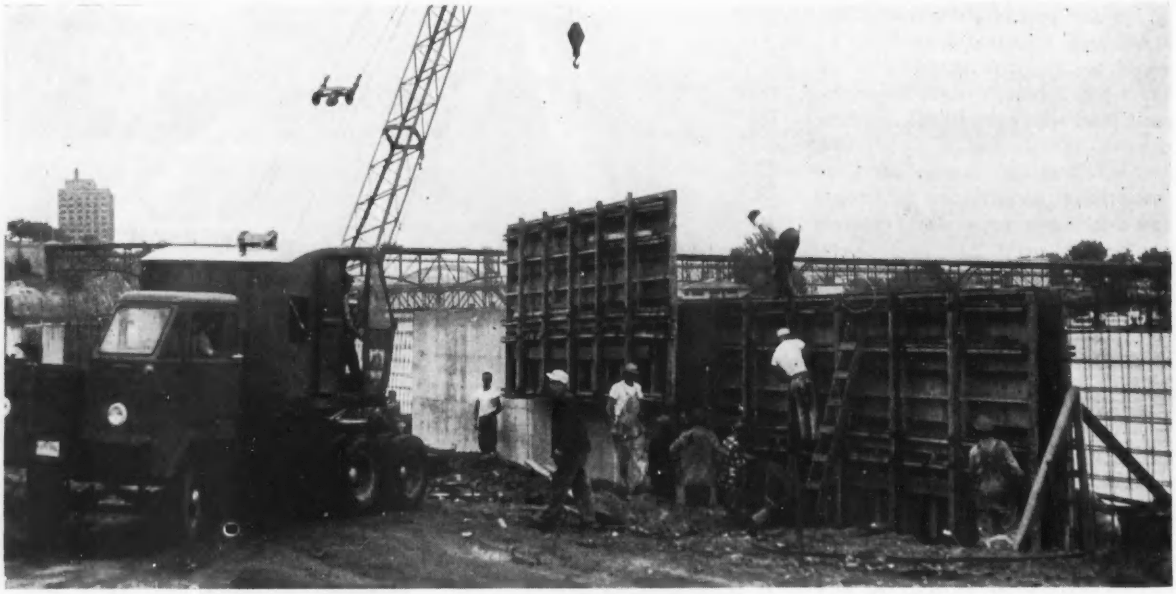
## BLOCK

### advantages

Public acceptance
Cost advantage
Quicker
Block always available
Mason's familiarity
Cracks easily repaired
Partition walls easier to build
Accoustical absorption-plants will take back surplus

### disadvantages

Call backs
Structural failures
Leakage
Fresh block shrinkage
Chipped block — poor appearance



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## POURED

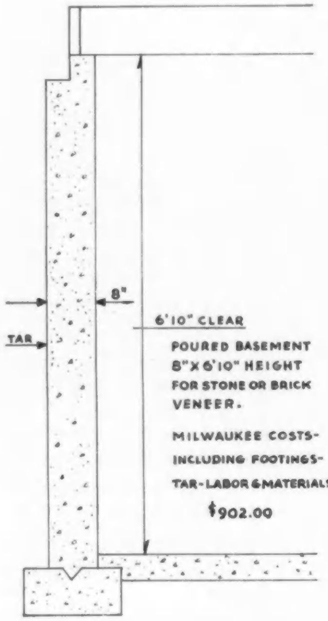
| advantages | disadvantages |
|---|---|
| Stronger | Curing time longer (4 days) |
| More waterproof | Few contractors |
| Finish more versatile | Cracks almost impossible to repair |
| Potentially lower cost | Winter work at present time more difficult |
| Fewer call backs | |

## BLOCK

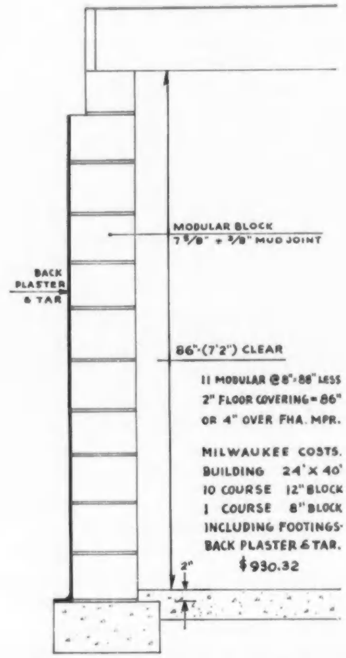
| advantages | disadvantages |
|---|---|
| Public acceptance | Call backs |
| Cost advantage | Structural failures |
| Quicker | Leakage |
| Block always available | Fresh block shrinkage |
| Mason's familiarity | Chipped block — poor appearance |
| Cracks easily repaired | |
| Partition walls easier to build | |
| Accoustical absorption-plants will take back surplus | |

# Comparative Costs—24x40 Foot Basements

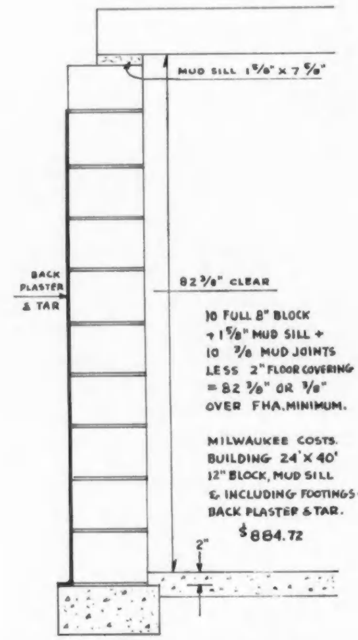
## veneer




**Poured: $902**

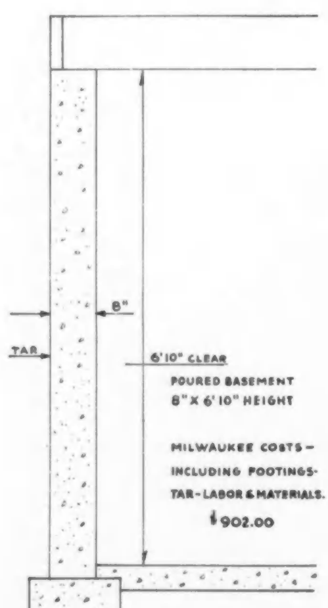



**Modular block: $930**




**8-inch block: $885**

## frame

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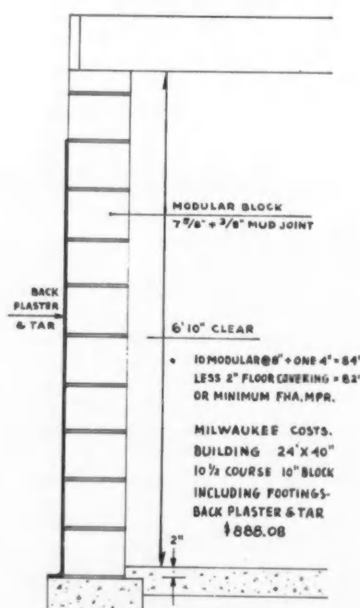
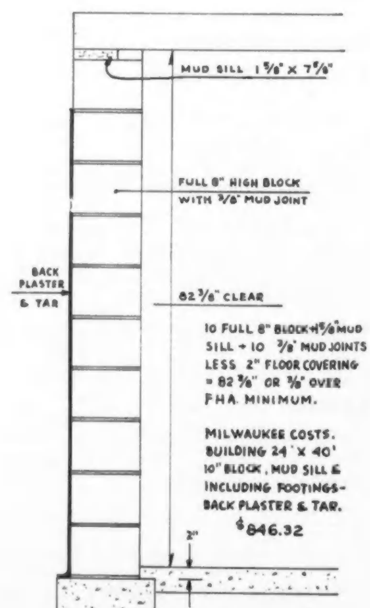



**Modular block: $888**




**8-inch block: $846**

Platform stamping tool used to imprint a tile pattern on fresh concrete.

**More details about light-weight aluminum tools that can be used for . . .**

# TILE STAMPING

A BRIEF ITEM in the equipment section of our September issue (page 20) describes a line of tile stamping tools developed by a California concern for imprinting brick and tile patterns on fresh concrete. Since the idea has considerable appeal, as well as elements of novelty, CONCRETE CONSTRUCTION has obtained some additional information for its readers.

The tools are constructed of a cast aluminum alloy, and are light enough for easy lifting by one man. According to the developer their use can cut costs 50 per cent under conventional walks, floors and patios in California homes.

Imprinting of the concrete is done in five steps. After framing, the concrete is poured in the usual manner and struck off. Color topping is then put on the surface of the wet slab. Next, the surface is troweled to the desired texture. Stamping tools are then applied to create the desired pattern.

A standard kit of tools for one pattern consists of three platform or walking units, two single unit tools, a single blade tool and a half blade tool. The platform tool is used to stamp large surfaces of the pattern along straight lines. It is so constructed that by placing one tool in front or by the side of another the user may walk on the tools and stamp the surface of the concrete in a continuous pattern. The other tools are used along irregular edges and other areas where the larger platforms cannot be used.

The tool company recommends that the concrete mix used with the stamping process should have aggregate not

exceeding one quarter inch, and that the cement content should be increased to provide the same richness as a standard mix.

Coloring is accomplished by dusting powdered pigment over the wet surface. This may be repeated during the troweling process. For a tile finish it is recommended that the surface be troweled as smooth as possible. It should be somewhat rougher for a brick finish.

After the slab has been stamped and cured for a period of not less than three days, the joints produced by the stamping tools may be filled with mortar, using either the dry process or the wet process.

A dry mortar, consisting of half sand and half cement, is used for the

Interesting basket-weave patterns on poured concrete sidewalks and patios made possible by the use of tile stamping tools.

former. The slab is wetted down. When the surface has dried but some dampness still remains in the joints, the dry mortar is swept across the surface and collects in the joints. The moisture left in the joints tends to set up the dry mortar. Wet sacks are then dragged across the surface. This is repeated with clean and progressively dryer sacks until all loose mortar has been removed. The same procedure is followed in the wet process, except that a wet mortar is used and pushed into the joints with a trowel or similar tool.

The accompanying photographs show the platform stamping tool in operation, and also some of the striking pattern effects that can be achieved.

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